

0 to 0.4 manganese, about 0.02 to 0.5 silicon, about 0 to 0.7 hafnium, about 0.0001 to 0.05 nitrogen, incidental impurities and deoxidizers.

REMARKS



Claims 1-19 are pending in the instant application.

Claims 2, 3, 8, 9, 14 and 15 stand rejected under 35 U.S.C. §112, first and second paragraphs, because according to the Examiner the specification does not reasonably provide enablement for the balancing compositions of the claimed gamma prime (γ') and gamma double prime (γ'') phases. The Examiner concludes, therefore, that the specification does not enable any person skilled in the art to make the invention commensurate in scope with the subject claims. The Examiner also considers these claims as being indefinite.

Claims 2, 3, 8, 9, 14 and 15 have been canceled without prejudice herein, thus making any traverse of this ground of rejection moot. Nevertheless, Applicants disagree with the Examiner on this rejection. It is well-known in the materials science/metallurgical art that the composition of an alloy determines or dictates which phases will be present and in what amounts. Applicants' narrowly defined composition as set forth in claims 1, 4-7, 10-13, and 16-19 inherently result in a nickel-base alloy containing between 8-20 weight % γ' phase and less than 2 weight % γ'' phase. It is elementary in the area of phase diagrams that the composition determines which phases will be present in an alloy. Even though Applicants believe that the present specification provides full enablement to persons skilled in the art to practice the invention with respect to the amounts of γ' and γ'' phases, claims 2, 3, 8, 9, 14 and 15 have nevertheless been canceled in a good-faith attempt to advance the prosecution of this application.

Independent alloy claims 1, 7 and 13 have been amended to further provide that the alloy is --resistant to carburizing, oxidizing, nitriding and/or sulfidizing environments--. Support for this amendment may be found on page 2, second paragraph and elsewhere in the

present application. Claims 1, 7 and 13 have also been amended herein to change the manganese range from "0 to 1" (claim 1), "0 to 0.8" (claim 7) and "0 to 0.6" (claim 13) to --0 to 0.4-- in all of these claims. Support for this manganese range may be found in the "Nominal Range" column of Table 1 on page 5 of the instant application, which discloses a "manganese (Mn) range of "0-0.4".

Applicants' invention is directed to a high temperature, high strength nickel-base alloy which contains a unique combination of microalloying elements to achieve extremely high levels of corrosion resistance in a broad spectrum of aggressive environments, including carburizing, oxidizing, nitriding and/or sulfidizing environments.

A nickel content of 42 to 58 wt.% provides an austenitic matrix for the alloy. An addition of 12 to 18 wt.% cobalt enhances the corrosion resistance of the alloy and contributes solid solution strengthening to the matrix. The addition of 21.5 to 28 wt.% Cr imparts oxidation resistance to the alloy. Cr levels below this range are inadequate for oxidation resistance and Cr levels above 28 wt.% produce detrimental Cr-containing precipitates. Molybdenum in a range of 4 to 10 wt.% contributes to stress corrosion cracking resistance and solid solution strengthening of the matrix. Aluminum in an amount of 2-3.5 wt.% contributes to oxidation resistance and strengthening of the matrix at intermediate temperatures.

When resistance to a sulfidizing environment is required, it is critical that the alloy of the present invention contain a minimum of 0.01 zirconium as a microalloying agent to stabilize the scale against inward migration of sulfur through its protective scale layer. Zirconium additions in excess of 0.6 wt.% adversely impact the alloy's fabricability.

When improved resistance to both oxidation and nitridation is desired and where carburization is necessary, it is also critical to add at least 0.005 wt.% yttrium. Yttrium levels above 0.1 wt.% increase the cost and decrease the hot workability of the alloy. As pointed out

on page 3, lines 24-27, only when optimum levels of 21.5-28 wt.% Cr, 2-3.5 wt.% Al and critical microalloying levels of 0.005-0.1 Y and 0.01 to 0.6 Zr are present in the alloy will outstanding corrosion resistance be achieved in the complete spectrum of carburizing, oxidizing, nitriding and/or sulfidizing environments. However, when only carburizing and oxidizing corrosion resistance is required, the microalloying with zirconium can be omitted from the composition and only yttrium need be employed (claims 1, 4-7, and 10-12). Where only sulfidizing and oxidizing corrosion resistance is required, yttrium can be omitted from the composition and only the microalloying addition of zirconium need be employed (claims 1, 4-7, and 10-12). Maximum overall corrosion resistance to all of the carburizing, oxidizing, nitriding and sulfidizing environments is achieved by the present alloy containing at least 2.75 wt.% aluminum, 0.01 wt.% zirconium and 0.01 wt.% yttrium (claims 13-19).

Claims 1-19 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-3, 5-8, 10-15, and 17-20 of co-pending Application No. 09/100,605. This is a provisional obviousness-type double patenting rejection because the conflicting claims have not, in fact, been patented. This provisional rejection will be addressed on the merits at such time as allowable subject matter is indicated in the co-pending application and in the instant application, and appropriate responsive measures, including terminal disclaimer, will be considered.

Claims 1-19 stand rejected under 35 U.S.C. §102(b), as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Shankar et al., Sileo et al., Twigg et al. or Grant et al.

Claims 1-6 stand rejected under 35 U.S.C. §102(b) as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Yakuwa et al.

All of the above prior art references applied in rejecting the claims were cited by Applicants.

In paragraph 15 of the Office Action, the Examiner states that the burden is on the Applicants to prove that the product of the prior art does necessarily or inherently possess characteristics attributed to the claimed product with respect to γ' or γ'' phase contents. This point is rendered moot by the cancellation of claims 2, 3, 8, 9, 14 and 15. Accordingly, no such showing need be made.

The Examiner states in paragraph 16 of the Office Action that Grant teaches about 28-45 wt.% Cr "which is about the claimed about 27 wt.% Cr as recited in claims 7 and 13." Claims 1, 7 and 13 have been amended to delete the word "about" preceding the Cr range. It is submitted that Grant's disclosure of a 28-45% Cr range with a preferred range of 30 to 40% Cr does not overlap and, thus, Grant et al. does not anticipate nor render obvious Applicants' claimed alloy composition having a Cr content of 21.5 to 27 wt.% Cr. As pointed out in the instant specification, Cr additions within the claimed range imparts oxidation resistance to the alloy and Cr additions above 28 wt.% (as taught by Grant et al.) produce detrimental Cr-containing precipitates, see page 3, first full paragraph of the instant application.

In paragraph 21 of the Office Action, the Examiner notes that the teaching of a prior art reference is not limited to preferred embodiments and that "unpreferred embodiments" must be considered in determining obviousness. The Examiner concludes by stating that under 35 U.S.C. §103, a reference must be considered not only for what it expressly teaches but also for what it fairly suggests. (Citations omitted here)

It is submitted that the Examiner has ignored what the various cited references fairly suggest to persons skilled in the art. For example, Applicants submitted a Declaration Under 37 C.F.R. §1.132 of Gaylord D. Smith on September 1, 2000, which evaluated and offered

opinions on the teachings and fair suggestions of the Sileo et al. reference. Mr. Smith is a person highly skilled in the art of Ni-base alloys and the Examiner has improperly chosen to ignore his opinions regarding the Sileo et al. reference. For example, Mr. Smith in paragraphs 6-9 considered the specific disclosure of Sileo et al. and concluded that the passage relied upon by the Examiner in col. 7, lines 48-59 is meaningless and non-enabling to persons skilled in the art due to the undue breadth of the constituent ranges, e.g., a Ni range of 0-91.9%. The Examiner counters this by saying that Sileo et al. teaches "nickel base superalloys" which, according to the Examiner, "is understood that 'nickel base' means nickel proportion is at least 50 wt.%", see paragraph 20 of Office Action. This conclusion is incorrect, since a "Ni-base alloy" merely means that the Ni content is greater than any other constituent (not required to be greater than 50 wt.%). In this regard, note that the present "Ni-base alloy" can contain as little as 42% Ni. This is but one example of the Examiner's attempt to substitute his opinion for that of the declarant, Mr. Smith. The Examiner is not a person skilled in the art and should recognize that fact and give proper weight to the Smith Declaration.

Mr. Smith describes what the Sileo et al. reference fairly suggests to one skilled in the art in paragraphs 6-8 and concludes in paragraph 9 that Sileo et al. does not suggest the claimed compositions of the present invention. This conclusion must be accorded proper weight by the Examiner. Reconsideration is respectfully requested.

In paragraph 10 of the Declaration, Mr. Smith expresses his opinion that because the compositions of Sileo et al. are in powder form, they are applied by plasma spraying to a substrate and that persons skilled in the art seeking a wrought nickel-base alloy capable of being hot or cold worked would not look to the plasma sprayed powder of Sileo et al. The Examiner once again completely ignores the opinion of the skilled artisan, Mr. Smith, and asserts his personal comments, namely, that "it is well settled that the form of reactants (here alloy) is

believed mere a choice between well known forms of such substances." The Examiner ignores the fact that there is a significant difference between the powder plasma spray coatings of Sileo et al. which are not subjected to conventional melting, rolling, etc. These spray coatings are not subject to cold or hot working and, therefore, are viewed differently by those skilled in the art.

In any event, it is clear that Applicants' claimed composition is neither taught nor suggested by Sileo et al. Note, particularly, that the importance of Mo in the amount of 4.5 to 9.5 wt.% is discussed in paragraph 11 of the Smith Declaration. Sileo et al. discloses a Mo range of 0-4 wt.%. It is pointed out in the Smith Declaration, as well as the instant specification, that this Mo range is critical to achieving the necessary stress corrosion cracking resistance as well as contributing to solid solution strengthening to the matrix. The Examiner states in paragraph 23 of the Office Action that the criticality of Mo should be established by factual evidence in the Declaration by way of comparative tests. It is submitted that such comparative testing is not necessary to overcome a reference such as Sileo et al. when there is absolutely no overlapping of ranges in the elements under consideration. Applicants claim a Mo range of 4.5 to 9.5 wt.% in claim 1, 4.5 to 9 wt.% Mo in claim 7, 5 to 8.5 wt.% Mo in claims 10 and 13, and 5 to 8 wt.% Mo in claims 16 and 18. Sileo et al. discloses a Mo content of 0 to 4 wt.%. Under these circumstances, no *prima facie* case of obviousness exists since there is no overlap in the Mo range. Accordingly, it is unnecessary and improper to require comparative tests regarding Mo content of Applicants' claimed alloy.

Of the remaining cited prior art, Shankar et al., Twigg et al. and Yakuwa et al., when each reference is reviewed as a whole, it is clear that none of these references teaches or fairly suggests the presently claimed invention.

Shankar et al. teaches a single crystal or a polycrystalline nickel or cobalt based alloy consisting of 5-40 % Cr. The present alloy requires 21.5 to 28 wt.% Cr in claim 1 for

oxidation resistance. Cr levels above 28 wt.% produce detrimental Cr-containing precipitates, see page 3, first full paragraph. No such limitation is present in Shankar et al. In fact, the extremely broad Cr range of 5-40 wt.% disclosed by Shankar et al. is so wide that it encompasses more than one-half of the wrought compositions of alloys presently commercially produced by Applicants' assignee. As disclosed in col. 3, line 11, the alloy compositions of Shankar et al. are suited for the "single crystal casting technique" and contain Mn in an amount of from 0.1 to 12%, preferably 0.5 to 4%, col. 3, lines 91-20. Shankar et al. goes on to teach at col. 3, lines 51-55 a single crystal preferred Ni-based composition containing 8 to 16 wt.% Cr and 5-10 wt.% Co and highlights the importance of Mn at col. 4, lines 35-43. The alloy compositions shown in the Table set forth in columns 3-4 and 5-6 of Shankar et al. indicate the importance of Mn in amounts from 0.5 to 2.5 wt.%. Claim 7 of Shankar et al. is specifically directed to a polycrystalline nickel-based alloy for gas turbine engine components and contains 0.5 to 12 wt.% Mn. It will be noted that in Applicants' claimed invention, Mn is not a critical constituent as in Shankar et al., since Applicants' claimed Mn range is 0-0.4 wt.%. It is also noted that Shankar et al. fairly teaches a Cr range of 8 to 16 wt.%, with actual examples ranging from 9 to 19 wt.% Cr, which is likewise avoided by Applicants' claimed Cr range of 21.5 to 28 wt.%.

Twigg et al. discloses a Ni-Cr-Co alloy containing 0.5 to 2% Mo, col. 2, line 9. Twigg et al. teaches at col. 3, lines 48-54 the criticality of maintaining the Mo content to no more than 2% so as to not adversely affect the impact strength after prolonged heating at 850°C. Applicants' claimed Mo range of 4 to 9.5 wt.% completely avoids Twigg et al., rendering the alloy patentable thereover.

Yakuwa et al. teaches a high-temperature sulfidation-corrosion resistant nickel-base alloy which includes 12-15% Co, 18-21% Cr, 3.5-5% Mo, 0.02-0.1% C, 2.75% max. Ti, at least 1.6% Al, and the balance being essentially nickel. The alloy may also include 0.003-0.01%

B and 0.02-0.08% Zr. The alloy is said to be useful in gas expander turbines for energy recovery in a petroleum refining plant. The present invention patentably defines over Yakuwa et al. with respect to the Cr range of 21.5-28% of claim 1, 21.5-27% Cr of claim 7 and 22-27% Cr of claim 13. Yakuwa et al. also fails to teach or suggest the criticality of at least one of 0.005-0.1 Y and 0.01-0.6 Zr in claim 1 for both oxidation and nitridation resistance. Further, Yakuwa et al. does not teach or suggest the additions of 0.01-0.8 Hf and 0.00001-0.08% N in order to stabilize the oxide scale to contribute to increased oxidation resistance as set forth in claim 7, for example.

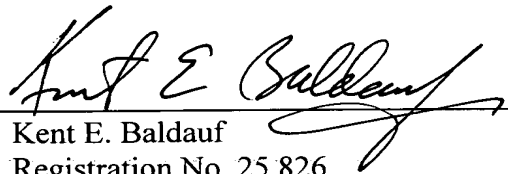
In addition, none of the cited prior art teaches or suggests the necessity of having both of the microalloying elements present, namely, 0.08 to 1.2 wt.% Ti and 0.01 to 0.07 Y as required in claims 13 and 16; 0.1 to 1 wt.% Ti and 0.01 to 0.07 wt.% Y as required in claim 17; 0.08 to 1.2 wt.% Ti and 0.01 to 0.06 wt.% Y in claim 18; or 0.1 to 1 wt.% Ti and 0.01 to 0.06 wt.% Y in claim 19. On this basis, claims 13 and 16-19 clearly represent a patentable advance over the cited prior art.

The Examiner's reconsideration and favorable action with respect to claims 1, 4-7, 10-13 and 16-19 are respectfully requested.

Respectfully submitted,

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MARKED-UP CLAIMS 1, 7 and 13:

1. (Twice Amended) A nickel-base alloy resistant to carburizing, oxidizing, nitriding and/or sulfidizing environments, consisting of, in weight percent, about 42 to 58 nickel, [about] 21.5 to 28 chromium, about 12 to 18 cobalt, about 4.5 to 9.5 molybdenum, about 2 to 3.5 aluminum, about 0.05 to 2 titanium, at least one microalloying agent selected from the group consisting of about 0.005 to 0.1 yttrium and about 0.01 to 0.6 zirconium, about 0.01 to 0.15 carbon, about 0 to 0.01 boron, about 0 to 4 iron, about 0 to [1] 0.4 manganese, about 0 to 1 silicon, about 0 to 1 hafnium, about 0 to 0.4 niobium, about 0 to 0.1 nitrogen, incidental impurities and deoxidizers.

7. (Once Amended) A nickel-base alloy resistant to carburizing, oxidizing, nitriding and/or sulfidizing environments, consisting of, in weight percent, about 43 to 57 nickel, [about] 21.5 to 27 chromium, about 12.5 to 17.5 cobalt, about 4.5 to 9 molybdenum, about 2.25 to 3.5 aluminum, about 0.06 to 1.6 titanium, at least one microalloying agent selected from the group consisting of about 0.01 to 0.08 yttrium and about 0.01 to 0.5 zirconium, about 0.01 to 0.14 carbon, about 0.0001 to 0.01 boron, about 0 to 3 iron, about 0 to [0.8] 0.4 manganese, about 0.01 to 1 silicon, about 0.01 to 0.8 hafnium, about 0.00001 to 0.08 nitrogen, incidental impurities and deoxidizers.

13. (Once Amended) A nickel-base alloy resistant to carburizing, oxidizing, nitriding and/or sulfidizing environment, consisting of, in weight percent, about 44 to 50 nickel, [about] 22 to 27 chromium, about 13 to 17 cobalt, about 5 to 8.5 molybdenum, about 2.5 to 3.5 aluminum, about 0.08 to 1.2 titanium, about 0.01 to 0.07 yttrium, about 0.02

to 0.5 zirconium, about 0.01 to 0.12 carbon, about 0.001 to 0.009 boron, about 0.1 to 2.5 iron, about 0 to [0.6] 0.4 manganese, about 0.02 to 0.5 silicon, about 0 to 0.7 hafnium, about 0.0001 to 0.05 nitrogen, incidental impurities and deoxidizers.